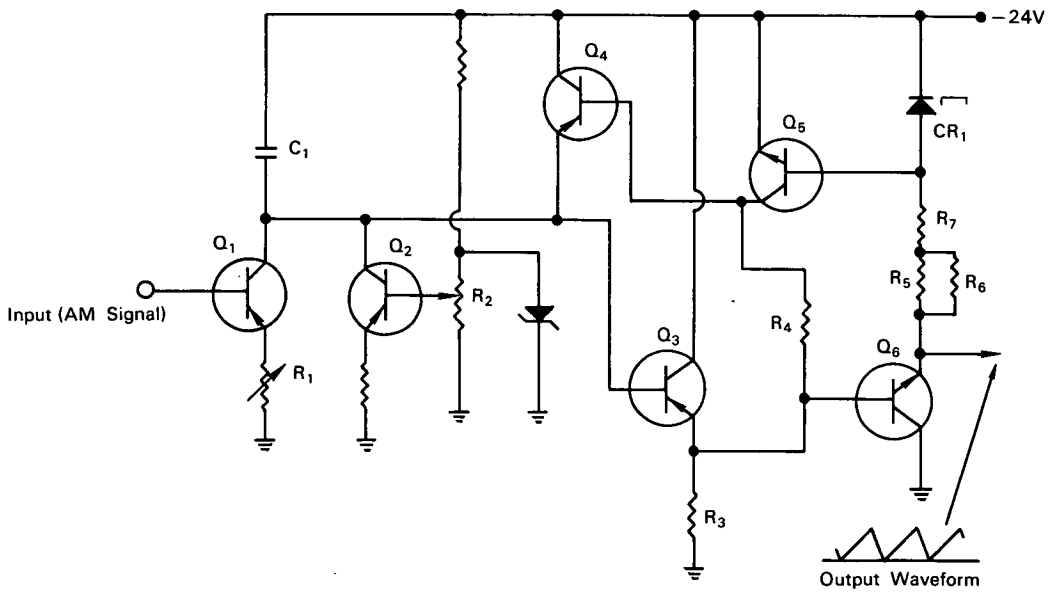
NASA TECH BRIEF

Circuit Converts AM Signals to FM for Magnetic Recording



The problem: To find an improved method of converting AM signals to FM for magnetic recording. The new circuit should be less complex and more linear and reliable than existing methods.

The solution: A relaxation-type voltage-controlled oscillator (VCO) that produces a triangular output waveform at a frequency that is proportional (either directly or inversely) to the voltage of the varying AM input signal. A conventional multivibrator converts this triangular output waveform to a square-wave input to the recording device.

How it's done: Oscillation is produced in the circuit by the charging and discharging of the capacitor C_1. Its rate of charge, or frequency of oscillation, is controlled by current flow through Q_1 and Q_2. The current flowing in the collector circuit of Q_1 is proportional to the varying voltage (the AM input signal) across the base-emitter junction. Adjustment of R_1 controls the amount of deviation from its center frequency of the FM signal for a fixed input signal. The current flowing in the collector circuit of Q_2 provides a constant current source in addition to the varying source from Q_1. Varying R_2 adjusts the current through Q_2, thus controlling the center frequency of the VCO. CR_1 is a tunnel diode used to perform current sensing and switching. Q_4, Q_5, and R_4 discharge C_1 on signal from CR_1. Q_3, Q_6, and R_3 form an isolation amplifier to prevent the sensing and switching circuit from loading C_1. As C_1 charges, the voltage across it increases and appears across the series connection of the emitter-base junctions of Q_3 and Q_6,

(continued overleaf)

parallel resistors R_5 and R_6, R_7, and CR_1. Q_5 is held at cutoff by voltage divider CR_1, Q_6, R_7, R_5, and R_6. Direct coupling of Q_5 to Q_4 prevents Q_4 from discharging C_1. As the voltage across CR_1 exceeds its peak point, CR_1 switches to its high-resistance state causing current flow in the base-emitter junction of Q_5 and a corresponding increase in current flow in the collector circuits of Q_5 and Q_4. The drop in impedance at the collector of Q_4 discharges C_1. When the voltage across C_1 drops sufficiently, CR_1 switches to its low-resistance state and Q_4 is cut off. The triangular output waveform appears at the emitter of Q_6.

Notes:

1. This circuitry should be of interest to designers and manufacturers of radar, telemetry, and test equipment.
2. Inquiries concerning this innovation may be directed to:

   Technology Utilization Officer
   Goddard Space Flight Center
   Greenbelt, Maryland, 20771
   Reference: B65-10001

Patent status: NASA encourages commercial use of this innovation. No patent action is contemplated.

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